

phenomena that baffle him. To fly at once to the hypothesis of direct "intervention" by a "higher intelligence" is as much as to say that a science of life is impossible. It is not our province to enter into the theological aspects of the matter; we would only remark that the author's language on this head appears to us to be a curious instance of survival from a bygone epoch. When, as in the eighteenth century, deistic conceptions of nature were rife, the idea of "interference" or "intervention" rose easily enough in the minds of devout persons. The only alternative seemed to be the complete banishment of the Deity from his universe. But in so far as deism is discredited by evolution, its correlative notion of "interference" must share in that discredit; and it is, to say the least of it, somewhat surprising to find the idea revived in the supposed interests of religion by one who, like the "Semi-Darwinian," professes neither to "question the general doctrine of evolution" nor to "desire to disturb the position of the 'Origin of Species' as an epoch-making book."

F. A. D.

WATER SUPPLY.

Water Supply. A Student's Handbook on the Conditions Governing the Selection of Sources and the Distribution of Water. By Reginald E. Middleton. Pp. ix+168. (London: Charles Griffin and Co., Ltd., 1903.) Price 8s. 6d. net.

THE provision of a pure and ample water supply is constantly growing in importance with the development of sanitary science and the rapid increase of the population in cities and large towns; whilst adequate and unpolluted sources of supply have to be sought at greater distances away, and in a country of limited area, such as England, will before very long become difficult to obtain, yielding sufficient quantities of water to meet the growing requirements of the inhabitants. Accordingly, water supply has within recent years become one of the most universally needed branches of engineering; whereas increasing difficulties are encountered in the execution of the requisite works. The enhanced value and interest thereby conferred on works providing supplies of water, have naturally led to the publication of several books on the subject in the last few years; but the present book differs from its more elaborate and comprehensive predecessors, in dealing with principles rather than with practice, and in being intended as a sort of introduction to those larger books, and for engineering students rather than for engineers.

The first introductory chapter gives a rapid sketch, within the limits of six pages, of the various points which have to be taken into consideration in devising a scheme of water supply, from the selection of a source to the delivery of the water to the consumer; and it provides a clear and useful summary of the questions which form the subjects of the succeeding chapters. The second and third chapters deal respectively with the requirements as to the quality and the quantity of water, the former describing the mineral and organic impurities liable to be found in water, the sources from which they are derived, and their relative importance;

whilst the latter explains the variation in the daily consumption per head of population in different localities, under different conditions, at different seasons, and according to the amount of waste; also the provision necessary for increase in population, the method of measuring rainfall, the gauging of the discharge of streams and rivers, and the estimation of the available yield from the different sources of supply.

In the following chapter, on storage reservoirs, the form and construction of earthen dams, and the various arrangements resorted to for regulating the discharge of the water from the outlet of reservoirs, are the main subjects dealt with; and under the heading "Compensation Water," concluding the chapter, after explaining this important requirement, a description is somewhat irrelevantly added of the earthen embankments of the Staines reservoirs, with which the author is professionally connected, the only definite reference to an executed work given in the book. The next chapter is devoted to the calculations of stability of masonry dams by analytical methods, but a graphical treatment of the statical problems involved would be found both clearer and simpler. An interesting description is given in chapter vi. of the purification of water by the ordinary English system of slow filtration through sand; and a brief reference is made at the end of the chapter to the American system of rapid filtration by aid of a coagulant, usually aluminium sulphate, introduced into the water.

The construction of service reservoirs for providing against fluctuations in the consumption is considered in a short chapter; and it is followed by a fairly complete investigation of the flow of water through pipes, occupying twenty-seven pages. The last three of the eleven chapters in the book, relating to distribution systems, pumping machinery, and requirements in connection with waterworks, together covering less than nine pages, add more to the number of chapters and the apparent scope of the book than to actual information about waterworks, the last chapter, more particularly, consisting simply of an appeal for the collection of additional and more detailed statistics in regard to rainfall, evaporation, the discharge of rivers and streams, and other matters pertaining to water supply. The book is illustrated by four folding plates and sixty-six figures in the text, and a short index is added at the end.

Though some subjects, such as aqueducts from impounding reservoirs, water meters, and sections of typical masonry dams are not described, and the information about springs and wells is scanty, and the book, therefore, does not provide a complete account of waterworks, it gives a considerable amount of practical information, combined with valuable suggestions for the guidance of waterworks' engineers in several of the chapters. The way, however, in which the book is written renders it more likely to be used for reference than for reading straight through; and, moreover, the number of short paragraphs into which it is broken up, even when treating of a single subject, is calculated to distract the reader. Nevertheless, the engineering student will find a considerable store of useful information and valuable hints dispersed

throughout the book; and it should serve as a convenient guide for leading on students to the intelligent study of more complete and elaborate treatises on water supply.

THE MATHEMATICAL THEORY OF CRYSTAL STRUCTURE.

Mathematical Crystallography and the Theory of Groups of Movements. By Harold Hilton, M.A. Pp. xii+262; with 188 figures in the text. (Oxford: Clarendon Press, 1903.) Price 14s. net.

UNDER the fostering care of the energetic professor a small but vigorous school of mineralogy is growing up at Oxford. We are not surprised to note in the preface that it was due to Prof. Miers's suggestion that Mr. Hilton undertook the task which he has so successfully accomplished. Mr. Hilton has had a distinguished career at Oxford, and it is with pleasure we observe that a mathematician of his attainments has turned his attention to a subject which receives such scanty consideration in this country.

Mr. Hilton's book appears at an opportune moment, since it is the generally accepted idea that the geometrical theory of crystal structure has reached something like finality. A good historical account of the development of the subject is contained in the British Association Report, 1901, and the present work supplements that survey by supplying the detailed reasoning. The scope of the book is more restricted than the rather wide title would lead a reader to suppose, and it is almost wholly concerned with the symmetry and structure of crystals. With the exception of a few chapters, it follows closely Schönflies's "*Krystall-systeme und Krystallstruktur*," but some features are introduced from the writings of Jordan, Fedorow and Barlow. Very slight allusion is made to Sohncke's work. We think it would have added to the value of the book had a page or two been devoted to his systems. Of course, they appear among the space-groups; but at the same time some Sohncke-system forms the basis of every space-group. This is Barlow's way of considering the subject, and may be found easier of comprehension by many readers, especially if the theory of groups be new to them. The book is distinguished by the fine series of diagrams of the space-groups, which have been drawn independently in the way suggested by Fedorow. The explanation of the figures, which is given on p. 171, might have been made more conspicuous so as to catch the eye more readily. The absence of such diagrams appreciably adds to the difficulty of understanding Schönflies's work.

Mr. Hilton divides his book into two parts. In the first he determines the thirty-two classes of centrosymmetry, which obey the law of rational indices and are therefore alone applicable to crystals. Another, and perhaps more logical method, is to assume that crystalline structure is cross-grained; that is to say, that a lower limit can be found to the distances between the elementary parts, whatever they may be. With this assumption, it may be shown that the only possible axes of symmetry have respectively 2-, 3-, 4- and 6-fold symmetry. The law of rational indices

alone is not entirely satisfactory on account of a peculiar case of pseudotrigonal symmetry which in that way arises. This part includes an elaborate chapter on the coordinates of equivalent points, and a chapter of considerable interest on the growth of crystals.

The second part corresponds very closely to the second part of Schönflies's book. After determining the fourteen varieties of lattices, the author discusses the properties of geometrical operations and the infinite groups of movements. The dynamical flavour which unavoidably clings to the subject is unfortunate, and without a note of warning the reader may be misled into the idea that something in the nature of a movement does actually occur. On p. 159 the author proves the fundamental proposition connecting the space-groups with the corresponding point- and translation-groups, and in the succeeding six chapters he deduces the 230 space-groups belonging to the six systems. A chapter follows on the partitioning of space, with special reference to Schönflies's elementary cell.

In the next chapter, on crystal-molecules, mention is made of attempts that have been made to assign arrangements to particular substances. It may be noted that at the present day there is a tendency to regard the molecules which compose a crystal, or rather their spheres of influence, as being in contact. In that case Barlow's theory of closest-packing would have some justification. A brief historical sketch brings the book to a close.

Mr. Hilton has prepared a masterly exposition of a difficult subject, and we can heartily commend the book to the attention of crystallographers.

OUR BOOK SHELF.

Das Haar, die Haarkrankheiten, ihre Behandlung und die Haarpflege. By Dr. J. Pohl. Fifth revised and enlarged edition. Pp. 178. (Stuttgart: Deutsch Verlags Anst., 1902.)

THIS is a popular treatise upon a subject which has received too little attention from scientific observers. The first part of the work deals with the structure and development of the human hair, with a brief account of the methods of investigation. The author, with the painstaking thoroughness of the German savant, has made a large number of researches into the rate of growth and the normal fall of the hair. The common belief that cutting the hair promotes its growth is shown to be erroneous. Each hair has, on the average, a normal life of about seven years, at the end of which time it falls out and is replaced by a new one. In health there is a normal fall of hair which varies somewhat with the age of the individual.

The second part of the work is devoted to the diseases of the hair and their treatment, and to the care of the hair. The author considers that in most cases oil or pomade is beneficial, but he insists that the quantity applied must be small. The vexed question of washing the hair is discussed. In individuals in whom the scalp is healthy, Dr. Pohl is of opinion that too frequent washing is inadvisable. He advocates the use of bran, yolk of egg, and other demulcents in the water used. Rapid and thorough drying of the hair after washing is insisted upon, especially for ladies.